CMPE118 Midterm Exam

(Practice Exam)

Name:_____(1)

I Certify that I have taken this examination in compliance with the University of California Honor Code.

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This is the cover sheet for what you turn in !

#1_____ / 5

#2_____ /20

#3_____ /10

#4_____ /20

#5_____ /20

#6_____ /25

Total_____ /100

Problem #1 5 Points

What are the Golden Rules for Op-Amps ? Be sure to be complete.

Problem #2 20 Points

You have been asked to build an apparatus to measure the amplitude of a sensor signal. From the specifications, you know that the frequency will vary between 1Hz & 2Hz. After measuring the signal, you discover that there is a relatively large (0.3V) signal at 200Hz coming in on the sensor signal. You are to design a circuit to amplify the sensor signal by a factor of 10 while suppressing the 200Hz signal to below 0.1V, measured at the output of your amplifier. Use standard component values.

Problem #3 10 Points

Given a 5V supply and a 74HC04, design a circuit to use the output of the 'HC04 to light 3 LEDs (V_f = 1.5V @ 4mA). For an added challenge, use only a single gate from the 'HC04. In either case, choose standard component values.

Problem #4 20 Points

You have been given a mobile platform driven by two independently controlled DC motors each with two possible speeds and three on-off reflectance sensors. The platform's task is to follow a black line on the floor. Design a state machine to implement a control strategy that attempts to follow the line at the fastest possible speed. Your design should be capable of detecting and responding to turns, both gentle (>6" radius) and sharp (45°, no radius), but not right angle turns. The three sensors are mounted at the front of the machine, with the central sensor positioned slightly ahead of the left and right sensors. The width of the tape is such that, when centered, all sensors are facing the tape.
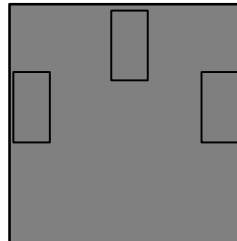
Problem #6 25 Points

Given a permanent magnet DC motor with a measured stall torque of 28 in.-oz., a no load speed of 1160 RPM (both at 12V) and a measured armature resistance of 2Ω., estimate:

a)   The Torque Constant, K_t.

b)   The stall current.

In a specific application, the motor will driven from a 15V source and is required to deliver 10 in-oz at 500rpm,

c)   Show that the motor can meet this requirement.

d)   Estimate the required drive duty cycle when operating at this speed-load point.

e)   Estimate the motor current when operating at this speed-load point.

You may assume that there are no internal losses within the motor. Quote specifications and show calculations to back up your answers. Note, that due to simplifications in the models presented, calculated parameters may differ by a few percent if calculated using different approaches. This is normal and acceptable.